SUMMARY

In summary, the aerobiologist places a biological system, the bacteria, in a hostile and ill-defined environment, the atmosphere, for the purpose of studying air-bacterium interactions. Measurement of this interaction is in terms of survival. Survival has been shown to depend not only on physicochemical reactions of the somatic, structural components of the cell, but also on those functional, physiological, dynamic properties of all living systems, termed adaptability or responsiveness. The problem, whether one is assaying infectivity or is searching for clues pertinent to death mechanisms, is to separate the two effects.

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Discussion

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In the experiments which Dr. Hatch has described, the immediate effect of an abrupt change in relative humidity on an airborne microorganism was expressed as a deviation from the expected reduction in aerosol concentration due to the dilution by the additional air introduced at the confluence point. The biological dilution ratio, based on samples, was compared with the apparent dilution ratio based upon light scatter measurements. The biological loss observed during the 5.7-min aerosol transit time in the second half of the apparatus was compared with the equivalent loss observed in the first half, and was expressed as the dynamic humidity death ratio.

Regarding the immediate effects of an abrupt change in relative humidity on airborne microorganisms, one might suggest that not only are the effects dependent upon the direction and magnitude of the change but, perhaps, also upon the

rate of change of relative humidity. If, in the apparatus described, one assumes that the aerosol from the first tube mixes perfectly with the additional air introduced at the confluence point and that temperature is constant throughout, one wonders what time is required to achieve uniform relative humidity in the mixed aerosol beyond the confluence point. With adequate mixing, the equilibration time is probably rather short and dependent upon the diffusion rate of water vapor. One could perhaps assume that the small airborne particles containing microorganisms come to equilibrium with their micro-environment at a rate greater than that at which the environment is changing. Undoubtedly the equilibration rate of the airborne microorganisms with their environment would be influenced by the nature of the material in the particle deposited by evaporation of the suspending fluid from which the microorganisms were originally atomized. Other factors such as strain of a given species and the age of a culture and its metabolic state, as influenced by temperature or chemical composition of the suspending fluid, also have been shown to affect the behavior of airborne microorganisms subjected to an additional stress such as a change in relative humidity.

A differing biological loss observed during the initial and final 5.7-min aerosol transit periods was identified by Dr. Hatch as the dynamic humidity death ratio and was based upon the assumption that first order kinetics were followed during the initial and final aerosol transit periods. Assuming that a simple exponential decay does occur, one could as readily express the biological loss as a decay rate, which could perhaps be useful in predicting biological loss for time periods other than those obtained in this apparatus. In addition, by computing decay rates, one could separate the physical and total loss, as measured by light scatter and sampling, respectively, to obtain a true biological decay rate. In using light scatter measurements to indicate particulate concentration of an aerosol, one must be aware of the fact that the light scattered from a sample of the aerosol is not restricted to particles carrying microorganisms.

The employment of a mixed aerosol containing the test organism and a tracer such as *Bacillus subtilis* spores is suggested, since, from the test organism-tracer ratio, one can obtain viability data independent of sampler efficiency and the extent of aerosol dilution. To eliminate the influence of a possible biological loss of the tracer, one could employ radioactively tagged microorganisms as a nonviable tracer.

Such tracer techniques would also be of assistance in elucidating the "tailing" or deviations from an exponential decay rate which have sometimes been observed after a change in relative humidity.